Forest Insect and Disease Management in Armenia

By
Gerard D. Hertel
West Chester University
and
Cynthia L. Snyder
USDA Forest Service, Alaska Region

United States Department of Agriculture, Forest Service
Forest Health Protection

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Summary

During May and June of 2004, Dr. Gerard Hertel, West Chester University and Cynthia Snyder visited the Republic of Armenia. The purpose of the visit was to evaluate the forest insect and disease problems in Armenia, the organization of how these problems are managed, and to make recommendations on how to deal with these problems in the future. During the visit a number of professionals involved in forest, and insect and disease management and issues were interviewed, a number of forested areas with insect and disease problems were visited, and available publications and literature available to forest managers was reviewed. The report describes in more detail the condition of the Armenian forests and provides general statements on observations of the program. It also provides recommendations for a Forest Insect and Disease Management and Pesticide Use and Coordination Program. The following is a summary of the recommendations for continued development and evaluation of the forest pest management program.

1. There are insect and disease problems that will require control actions.
2. Technical specialists should be hired or contracted to provide leadership and technical expertise in dealing with these problems.
3. There is a need for better documentation of insect and disease conditions, their control, and the success or failure of that control.
4. Educational materials and training are needed for forest guards and foresters in the Forest Enterprises, National Parks and protected areas so that accurate insect and disease identifications can be made.
5. The reliance on aerial application of pesticides should be reassessed as the control method of choice. Training should be provided on effective and safe aerial application technology.
6. During the visit, only qualitative information could be collected, therefore, a more comprehensive evaluation should be done using Armenian integrated pest management specialists working side-by-side with other experts.

Forest Insect and Disease Management in Armenia

I. Introduction and Background

The Republic of Armenia is located in the southern Caucasus Mountains of southwestern Asia (Figure 1). It is the smallest of the former Soviet republics with an area of 29,800 square kilometers (slightly smaller than Maryland). Since its independence from the former Soviet Union in 1991, Armenia has emerged as a strategically important country in the Caucasus, and its progress towards becoming a stable democratic country with a market-based economy is important to U.S. security and economic interests in the region. U.S. ties to Armenia are many and varied, ranging from the cultural bond of the large Armenian-American Diaspora community, to diverse commercial interests and broader political relationships.

Figure 1. This map shows the location of the Republic of Armenia in relation to the countries of southwestern Asia

Prior to the 1992 opening of the first US Embassy in Yerevan, Armenia suffered from a number of devastating incidents. In 1988, the country was struck by a major earthquake that killed over 25,000 people. In 1989, Turkey imposed a trade embargo against Armenia because of the unresolved conflict with Azerbaijan over the Nagorno-Karabakh region. In 1991, independence from the Soviet Union resulted in an economic collapse and severe energy shortage. To address the enormous humanitarian crisis, US programs, from 1992 to 1995, focused on humanitarian assistance through USAID. Beginning in 1995, as the humanitarian crises began to lessen and the government of

Armenia was taking steps toward economic reform, USAID programs gradually shifted to a more developmental focus. From 1995 to the present, US assistance has increasingly emphasized systemic reform and institution-building.

Federal programs administered by the USDA are in place to promote and support agriculture (USDAMAP USDA Marketing Assistance Project), however, the USDA Forest Service is not a part of the effort. In March of 2004, two Forest Service employees were chosen to provide assistance to Armenia to evaluate insect and disease problems, the organization for how these problems are evaluated and to make recommendations for how best to deal with future problems . The dates of this assignment were from May 31 through June 13, 2004. The team was composed of: Cynthia Snyder (biological technician, Forest Health Protection, Alaska Region), Gerard Hertel (retired USDA, now with West Chester University of Pennsylvania), Armen Gevorgyan (World Bank Natural Resources Management and Poverty Reduction Project (NRMPR), Program Implementation Unit (PIU), State Forest Management Component), Ruzanna Martirosyan (translator provided by NRMPR PIU), and Artashes Manaseryan (Hayantar SNCO (State Noncommercial Organization), the Armenian equivalent of the Forest Service) (Figures 2 and 3).

Figures 2 and 3. The team members: Gerard Hertel, Cynthia Snyder, Armen Gevorgyan, Ruzanna Martirosyan, and Artashes Manaseryan.

During the visit a number of interviews were conducted with Hyantar officials in Yerevan, and foresters at 10 of the 22 Forest Enterprises (the equivalent of National Forests) and Dilijan National Park, also with NGO's (Non Governmental Organizations), University professionals and local insect and disease specialists, and reviewed current publications dealing with Armenian forests and their associated problems.

II. Armenia's Forests

A. Forest Conditions and Problems

The forests of Armenia are concentrated in the mountainous north and far southeast regions with very little forest area in the central part of the country. Major forest species are oak, beech and hornbeam with various pine plantations (Figure 4). Since the beginning of the 20th century the forest cover of Armenia has decreased dramatically from 25% of its land area to barely 9%. The first thing that led to this decrease in forest cover was the period of industrial growth in from 1930-1950's. The energy crisis of 1991-94 following the collapse of the Soviet Union greatly accelerated the rate of forest loss for fuelwood. Seventy percent of the wood harvested in Armenia is for heating and cooking (500,000 cubic meters annually). The World Bank estimates that at the current rate, Armenia's forests will be eradicated in 20 years. This seems to be an exaggeration considering the remoteness, inaccessibility and steep slopes of many of the forests. However, this does not minimize the serious impacts people are having on the forests considering the low volume and density of existing forests (1,25 cubic meters/ha; 0.52).

Figure 4. Typical oak forest in central Armenia.

Seventy percent of the wood harvested in Armenia is for heating and cooking (500,000 cubic meters). Sanitation cuttings (removal of dead trees) are used for these

purposes and various wood products. Both legal and illegal cutting exert pressure on the forests; experts estimate that 1,250,000 cubic meters are harvested legally and illegally each year in Armenia. Grazing of livestock prevents forest regeneration in many locations. Tree nurseries are few and little tree planting is done by Hayantar (Armenia Tree Project, a Yerevan-based NGO, has tree nursery and planting programs for selected community lands).

Little forest management activity outside of sanitation cutting is done. Most forests are in place to protect various ecosystem functions and not for sustainable tree harvesting. The primary goal of managing the forest resource is for the many ecological benefits including soil conservation, climate regulation, air purification, water regulation, wildlife habitat and biodiversity protection, harvest of traditional foods, medicines, and ornaments, and recreation. The forests are very important to the Armenian people as can be seen by the many picnic areas and religious sites scattered throughout the landscape (Figure 5).

Figure 5. Kachkar (cross-stone) and remembrance flags found in an oak forest in northern Armenia.

Many sources mention the terrible condition of Armenia's forests and the problems that have led to the current situation. However, they usually do not mention the impacts of insects and diseases. It is believed by local specialists that unless due consideration is given to pests, efforts at forest management will end with insects and disease devastating most of the remaining forests.

B. Insect and Disease Loss Statements

Gabrielyan, V. *et al*. 2001. Forests and their significance for mountainous Armenia. Royal Netherlands Embassy in Kyiv. 111p (quote from pp. 95-6)

"In years of reproduction foliage-eating insect pests trees loose their foliage, and the growth of their timber is halted. Over the last 20 years foliage-eating insect pests have made 5-25thousand ha of forests leaf-less, and as a result of which the average annual losses of timber growth has constituted 17 thousand cubic meters in some years up to 30 cubic meters.
Around 200 types of disease viruses are recorded in Armenia, which are capable of mass reproduction. Oak forest are damaged by Microsphaera alphitodes, conifer trees, such as pine and spruce are damaged by Melamposoraceae belonging to Vredinales class"

RIO+10 National Assessment Report, Republic of Armenia, 2002 (p. 43)

"Forest Protection: In the recent years, the lack of forest protection measures and the vast and irregular logging have created a change in not only the climate conditions in forests (high temperature, abundant light), but also the fodder base(branches and leaves falling off as a result of logging). These factors have created extremely favorable conditions for the proliferation of pests and diseases. The endemic sources of pests progressively increased every year, and currently take up more than 30,000ha. Studies have shown that ubiquitous leaf deprivation of oak forests causes an annual loss of about 21,000 cubic meters of wood; which is equivalent to an assessed damage of 62 million drams"

Nalbandyan, A. *et al*. 1999 project: Pest and disease control in the forests of the republic of Armenia. Ministry of Nature Protection. 7pp (In Armenian)

"A 1999 survey indicated that 20,700 cubic meters of oak were killed with a value of 118,000USD. The prediction for 2003 is that 62,164ha would be infested and that 56,569 cubic meters of trees would be killed with a value of 303,000USD. If unchecked the impacts would include increased fire danger, flooding, soil erosion and landslides

2002 Risks and constraints related to proposed forest management. Tacis. Joint environmental programme JEP-06. Pre-Investment Study. Preparation of the Forest Management Component. Final Report. Annex 16 Appendix 8, 5pp.

"*It is predicted that as a consequence of climate change, the forest infected by phytophagus insects will increase from 15-20,000ha to about 60,000ha"*

Forest, biodiversity and nature management. Chapter 5, pp.51-65 (p.59)

"These organisms (pests and diseases) invade 15,000-25,000ha of forests each year"

Visit to **Aparan Forest Enterprise** June 7, 2004

Last year 1000ha of oak forest were sprayed for the browntail moth. This year there is an additional 1000ha infested. The forest that we visited was a coppice forest of about 3m in height. It was a result of illegal harvesting of 10m tall oak needed for heating and cooking. Continued feeding by the browntail moth will in a few years kill the young coppice growth. As the forest here is 90% oak, the impacts will all but eliminate the forest.

Visit to **Egihegis Forest Enterprise** June 8, 2004

3000ha of oak are dead as a result of feeding by caterpillars along with a concurrent drought. The dead oaks are 10m tall and 12-16cm diameter breast height. This area is about 80% oak and 20% ash. Many of the standing dead trees have coppice growth from the roots. Leaf-eating caterpillars are rare now but an increase in the near future would defoliate and kill the oak coppice and thus the whole oak forest.

All other Forest Enterprises we visited (see contact list in the Appendicies)

They all report a history of leaf eating insects (mostly the browntail moth). A few mentioned the leaf mildew on oaks as being a problem. Most would mention a current, but undocumented, infestation area of about 1000ha. The term "tree drying" was used to indicate a dead or dying tree.

C. Forest Ecological Benefits

Ecosystem Services Provided by Armenia's Forests
(for use in justifying control actions)

1. Gas regulation – intake and storage of carbon and production of oxygen.
2. Climate regulation – effects on precipitation and temperature. Release of water vapor influences rainfall.
3. Disturbance prevention – structure and storage capacity of vegetation can reduce effects of floods and droughts.
4. Water supply – filtration and storage of water for human consumption and use for agriculture.
5. Water regulation – influence on hydrological cycle and flow of surface water.
6. Soil retention – roots stabilize the soil and foliage intercepts rainfall.
7. Soil formation – accumulation of plant material.
8. Nutrient regulation – proper nutrient cycles are retained.
9. Waste treatment – forests can dilute, assimilate and chemically recompose a limited amount of animal and human waste. Trees filter pollutants from the air.
10. Pollination – forests provide habitats for many insects and birds that pollinate plants.

11. Biological control – prevention of outbreaks of insects and disease by natural enemies (living organisms in the forests – fungi, birds, spiders, viruses).
12. Habitat function – provides living space for plants and animals allowing for biological and genetic diversity. These forests are one of 25 international biodiversity hotspots. The designation is because of the large number of endemic organisms and the threat that they are under.
13. Food – wild plants and animals.
14. Raw materials – biotic renewable resources such as wood, energy sources (wood and other organic matter) and animal feed.
15. Medicinal resources – traditional medicines from the forest.
16. Ornamental resources – decorations (pine cones).
17. Aesthetics – people enjoy scenery and landscapes. Beautiful areas attract tourists and this may serve as a source of income for local people.
18. Recreation – places for relaxation and recreation; hiking, fishing, nature viewing; health.
19. Spiritual and historic information – forest ecosystems can provide humans with a sense of continuity and place, and can also be an important part of religion.
20. Science and education – study, research and education potential.

III. General Statements

1. The Forest Protection unit in Hayantar has been disbanded because of lack of funds. Pay is very low for current employees.
2. The forests of Armenia are made up mostly of oak, beech and hornbeam with various conifer plantations.
3. Insects (especially defoliators) have historically caused serious problems in the forests and continue to do so. Records of economic impacts of insects and diseases, and other activities by volume or acres would help track trends and losses.
4. The three most common defoliators (*Ocneria dispar, Malacosoma neustria and Euproctis chrisorrhoea*) were introduced into Armenia's native forests from other countries in the 1930's and 1940's. Outside of their native range, and away from their natural enemies, these insects once established have very serious impacts.
5. Information on tree disease is lacking. Forest pathologists have not been active in Armenia. There is no doubt that forest pathology will become more important as investigations are made and the forest matures. A higher priority must be given to this area.
6. There are two well trained and knowledgeable forest entomologists. One works with an NGO (he used to work for Hayantar) and the other with a research institute in the Ministry of Agriculture. They have no current resources with which to assist Hayantar.

7. No formal data or easy access to past (Soviet era) data exists to provide historical impact information and to serve as the basis for control decisions in the future.
8. Forest guards and foresters are not well trained to identify the most common insect and disease problems of the forests. They need good information (pest alerts with good pictures) and must consider the detection of insects and diseases an important part of their job. The upgrading of the Zikatar Training Center will provide a nice location for training.
9. Hayantar does not currently provide technical support for insects and disease identification to the Forest Enterprises or the National Parks.
10. Each year the forest enterprises submit a request to Yerevan for control projects. It appears these are usually for aerial application of pesticides. We were not aware of the supporting documentation or how the priorities for these projects are set.
11. Chemical and biological pesticides are the only control options mentioned and used. The good news is that the most biologically friendly preparations (e.g. B.t.) are being used.
12. Fruit and nut trees are an important component of community forests and their entomology and pathology is important. Hayantar specialists should develop some expertise in this area.
13. The Agriculture Academy, Faculty of Forestry, should develop a course in Integrated Forest Pest Management.
14. If tree nurseries become common again, seed and nursery pests would need to be studied and controlled as needed.
15. The Environmental Conservation Research Center of the American University of Armenia should be encouraged to include information about insects and disease of forest and fruit trees in their environmental education program.
16. We saw two books dated 1954 that the forester at Dilijan National Park was using to help identify pests (Miszoyan and Nubaryan. Pest Control of Forest Trees. Armenia State Publication; Mirsoyan and Sofyan. Pest and Diseases of Decorative Trees and their Control. National Academy of Armenia)
17. A forest inventory had been designed and will be carried out on two Forest Enterprises. A biodiversity index is included but we were not made aware of the details.
18. Where appropriate, insect and disease information should be included in the forest inventory (see http://www.ncrs.fs.fed.us/4801/field-guides/Current/NC-2004-field-guide.pdf pp.119-140)
19. The Forest Code speaks to insect and disease control often but should be updated to include insect and disease detection and the need for biological evaluations to support control decisions.
20. During the week of June 28, a Georgian contract spray plane crashed and the pilot was killed. This operation was not made known to the visiting team. We would suspect that an aviation safety and management plan should be developed. (see http://www.fs.fed.us/im/directives/fsm/5700/5720.txt and http://www.fs.fed.is/im/directives/fsm/5700/5700 zero code.txt).

IV. Recommendations for an Insect and Disease Management Program and Pesticide-Use Management & Coordination

A. Forest Insect and Disease Management

Basic Standards for Hayantar's Insect and Disease Management Program:

1. At least one full-time professional forest integrated pest management specialist (entomologist or pathologist).
2. A program that provides Forest Enterprise, National Park and Protected Area foresters with technical assistance and training in forest entomology and pathology.
3. A program to detect and map significant forest insects and diseases.
4. A program to evaluate the need for control actions against major forest insects and diseases.
5. A program that promotes the most effective and safe approach for insect and disease control.
6. A system that provides an annual report to the Minister of Agriculture on forest insect and disease conditions..

Basic Operating Guidelines for Hayantar's Insect and Disease Management Program

1. Objective: to reduce the impact of insects and diseases on forests and trees
2. Policy: it is the policy of Hayantar to:
    a. Develop, practice, and encourage insect and disease control that presents the least hazard to humans, wildlife, fish, and other components of the environment.
    b. Include integrated forest pest management considerations in forest plans.
    c. Provide technical assistance to the Forest Enterprises, National Parks and Protected Areas.
    d. Support safe control projects to reduce economic and ecological impacts resulting from pests.
    e. Consider forest management goals, economic efficiency, environmental protection, human safety, and potential effectiveness in selecting control actions.

3. Responsibility
    a. Yerevan Headquarters
        i. Provide national coordination for reporting and record keeping of insect and disease impacts and pest control projects.
        ii. Approve funding of control projects.
        iii. Provide leadership and support in integrated forest pest management and pesticide use.
        iv. Provide technical advice and guidance on:
            1. detection, evaluation and control of pests
            2. pesticides and pesticide use

v. Annually report to the Minister of Agriculture on forest insect and disease conditions and control projects.

b. Forest Enterprises/National Parks/Protected Areas
    i. Ensure full consideration of insect and disease management in all activities.
    ii. Conduct routine field surveillance to detect potentially damaging insects and diseases. Assign a professional staff member to serve as primary contact with integrated pest management specialist in Yerevan.
    iii. Conduct approved pest control projects in partnership with Yerevan headquarters.

4. Detection Surveys-Forest pest detection activities are geared to the early detection of insect and disease problems. Detection consists of two parts. The first part is the day-by-day field surveillance carried out by the forest guards and foresters in connection with their regular duties; the second part consists of planned systematic surveys conducted by the integrated pest management specialist from Yerevan. All problems should be documented and mapped.

5. Insect and Disease Management Evaluations. Evaluation of forest pest problems is the process of gathering, analyzing, and interpreting data, and presenting it in such a way that the forester is able to decide whether action is needed and, if so, to help decide which control technique is best. Evaluations consider:
    a. Biological Evaluation-biological appraisals of the potential, current, and post-treatment significance of insect and disease situations
        i. Risk evaluation-determine risks to forests and identify management options
        ii. Initial evaluation-determine pest occurrence and potential for unacceptable damage and need for treatment
        iii. Pretreatment evaluation-immediately before treatment to make sure treatment is warranted
        iv. Post-treatment evaluation-results of actions taken
    b. Economic Evaluation-of pest control options to determine the most economically efficient course of action
    c. Environmental Analyses-conduct environmental assessments to determine the potential effects on the environment/ecosystem of the proposed control actions

6. Control Project Standards
    a. Standards-before approved and financed, it must:
        i. Show strong potential for success and supported by a biological evaluation (see 5a) that supports the need for a control project
        ii. Be environmentally/ecologically acceptable and supported by a documented environmental impact assessment (see 5c)

iii. Be supported by an economic analysis (see 5b) sufficient to reflect benefits and costs

b. Required Documentation
   i. An environmental impact assessment
   ii. Biological evaluation
   iii. Economic evaluation
   iv. Approved pesticide use proposal
   v. Project work plan
   vi. Project safety plan

B. Pesticide-Use Management and Coordination

1. Objective; to ensure the proper use of pesticides
2. Policy. In managing and coordinating the use of pesticides, Hayantar's policy is to:
   a. Base actual use and recommended uses of pesticides on analyses of effectiveness, specificity, environmental impacts, economic efficiency and human exposure.
   b. Coordinate pesticide projects, as appropriate, with other Ministries.
   c. Ensure safe pesticide use.
   d. Ensure the judicious and effective application of all pesticides.
   e. Notify persons in treatment areas prior to the application of pesticides.
   f. Transport, store and dispose of pesticides and pesticide containers in accordance with applicable laws and regulations.
   g. Monitor sensitive environments during pesticide applications in order to evaluate unanticipated effects.
   h. Permit only qualified personnel or those under the supervision of a qualified applicator to use pesticides.
   i. Support research to develop and evaluate the effectiveness and environmental safety of new and improved pesticide formulations as well as human safety and application methods and to transfer this technology.
   j. To report to the Minister of Agriculture as soon as possible all pesticide incidents including pesticide spills, unplanned non-target pesticide applications, unusual occurrences of drift, unforeseen adverse effects on wildlife, or accidents with equipment including aircraft..

3. Responsibility

   a. Chief Forester, Hayantar
      i. Coordinate overall pesticide use in Hayantar.
   b. Forest Protection Chief, Hayantar, Yerevan
      i. Recommend national policies. Objectives, priorities, standards, and procedures for pesticide use, including direction on training in pesticide safety and certification of applicators.
      ii. Cooperate with other Ministry's concerned with pesticides.
      iii. Coordinate formulation on national research programs.

iv. Provide oversight and annual guidance to the Forest Enterprises on pesticide-use reporting.
v. Appoint pesticide-use management specialists

c. Integrated Pest Management Specialist, Yerevan
   i. advise and assist the Forest Enterprises on the interpretation of pesticide laws and direction on pesticide use
   ii. coordinate with other s interested in Hayantar's pesticide use activities
   iii. provide up-to-date information on pesticide registration and application techniques to the Forest Enterprises and National Parks
   iv. advise and assist Hayantar field units in preparing and reviewing documents associated with environmental analysis
   v. train personnel in the proper application and safe use of pesticides
   vi. provide reports and records of pesticide use

VI. Appendicies

Appendix A. Contacts

Country	Organization	Contacts	Address	Telephone/Fax E-Mail
Armenia	Natural Resources Management and Poverty Reduction	Armen Gevorgyan (primary contact), State Forest Component Coordinator Ruzanna Martirosyan (translator)	NRMPR PIU 35 Moskovyan St Yerevan, 375002	nrmprp@web.am 374-1-53-93-16
Armenia	World Bank	Gayane Minasyan		374-1-52-48-84 (ext. 401) 374-9-40-60-45 (cell) gminasyan@worldbank.org
Armenia	State Department U.S. Embassy	Traver Gudie (Economic and Commercial Officer)	Yerevan	374-1-58-00-85 (Engels) 374-1-52-46-61 (Gudie) GUDIET@state.gov
Armenia	USAID	Marina Vardanyan		374-1-54-38-35 mvardanyan@usaid.gov
Armenia	Eco-Globe NGO	Armen Nalbandyan (entomologist)	Arshakunyac 30/70 Yerevan, 375026	374-1-44-47-83 nmarmen@yahoo.com
Armenia	Armenian Forests NGO	Jeffrey Tufenkian	38 Moscovian St. Apt. 10 Yerevan 375002	jeffrey@armeinianforests.am 54-15-29 58-20-39

Armenia	Armenia Tree Project	Susan Yacubian Klein (Country Director) Jason Kauffeld (Deputy Director) Samvel Ghandilyan (Nursery Manager) Tigran Palazyan (chief propagator)	Aygestan 9th St, #6 Yerevan 375025	klein@arminco.com (3741) 55-30-69 fax (56-99-10)56.99.10 jasonkauffeld@hotmail.com
Armenia	USDA MAP	Jeffery E.Engels. Director	74 Teryan St. Yerevan 375009	374-1-560-014 jeffrey@usda.am
Armenia	USDA MAP	Charles Basham, Assistant Director	74 Teryan St. Yerevan 375009	374-1-560-014 (ext. 218)
Armenia	USDA MAP	Tigran Haroyan, Administrative Coordinator Ashot Stepanyan, airport expeditor		tharoyan@usda.am (09)40.6657 cell
Armenia	American University of Armenia	Charles Dunlap, Director Environmental Conservation & research Center Arthur Karapetian (GIS specialist)	40 Marshal Bagramian Ave Yerevan 375019	374.1.51-26-92 cdunlap@aua.am
Armenia	Europe Hotel	Karine	32-38 Hanrapetutyan Str Yerevan 375010	(3741) 54 60 60; 01-54 60 50 (fax) sales@europehotel.am
Armenia	Forest Institutional Support Project (FISP)	Siranush Galstyan (project assistant) Lilit Stepanyan (project coordinator) Andranik Ghulijanyan (FREC and training center coordinator)	Baghramyan Ave. 2, Apt. 28 Yerevan, Armenia 375010	(3741)58.14.36 (3741)54.07.19 fax fisp@netsys.am sir_galstian@yahoo.com
Armenia	Hyantar SNCO (State and Non-commercial Organization)	M. Matevosyan (director)	35 Moskovyan St Yerevan, 375002	
Armenia	Yerevan State University	Dr. Siranush Nanagulyan (mycologist)	Dept. of Botany	(3741)55.23.52 (3741)52.25.38(hm) snanagulyan@sun.ysu.am

Armenia	Ministry of Agriculture	Dr. Masis Sargsyan (forest entomologist and IPM specialist)	Agricultural and Plant Protection Scientific Center Village Merdzaban Echmizdin 378312	7.8852.264791 (3741)26.47.91
Armenia	Hyantar Tsahkadzor Forest Enterprise	Carlos Stepanyan (forester) Stepan Markaryan (chief forester)		
Armenia	Tshambarak Forest Enterprise	Agasi Harutyuynyan (deputy) Aram Eganyan (head) Karen Grigoryan (forester) Mekhak Eghiazaryan (forester)*		06523192
Armenia	Artsvaberd Forest Enterprise	Aretik Adamyan (head) Gainik Khadrateryan (engineer of forest culture)	Tavoush Marz Berd	06721283 06721227
Armenia	Noyemberyan Forest Enterprise	Vasil Chilingaryan (head) Gigor Khasikyan (forester)		

Armenia	Zikatar Forest Enterprise	Suren Gabrielyan (chief forester) Suren Amirzyan (forest engineer) Karen Grigoryan (forester)	Tavoush Marz Berdavan, Armenia	(066)(22222)26.63
Armenia	Jermuk Forest Enterprise	Ararat Targsyan (chief forester)	Jermuk	087.21042
Armenia	Goris Forest Enterprise			
Armenia	Kapan Forest Enterprise			
Armenia	Dilijan National Park	Ashot Davtyan (head) Mikle Sharbatyan (pest spec.)	Tiblisi Ave. 2 Dilijan, Armenia	(0680)70.32
Armenia	Ijevan Forest Enterprise	Samuel Antonyan	Gandzaker 94528	06322.229.45.28
Armenia	Eghihegis Forest Enterprise	Murad Harutyunyan (head) Eprem Grigoryan (forester) Eduard Gevorgyan (forest engineer) Samvel Agvaryan (chief forester) Hmayak Antonyan (chief forester)		
Finland	INDUFOR/University of Helsinki	Veli Pohjonen	Ollaksentie 5 Fin-01690 Vantaa	veli.pohjonen@kolumbus.fi
Ukraine	Ukrainian Forest Management Scientific Center	Vitaliy Storozhuk	50 Bratislavskaya Street Office 312 Kiev	38044.572.21.53 fmse@ukrpacky.net
USA	International Programs USDA Forest Service	Val Mezainis Director		intlprog@btsbti.net 202-205-1650
USA	World Bank	Adriana Damianova, Program Team Leader	Environment and Socially Sustainable Development Unit Europe and Central Asia Region World Bank	Adamianova@worldbank.org 202 473 2159/Fax. 202 614 0715

USA	West Chester University	Gerard Hertel	Department of Biology West Chester, PA 19393	610-436-0599 ghertel@wcupa.edu
USA	USDA Forest Service	Cynthia L. Snyder	State & Private Forestry/Forest Health Protection 3301 “C” St, Ste 202 Anchorage, AK 99503	907-743-9456 907-743-9479 fax clsnyder@fs.fed.us
USA	Armenia Tree Project, USA	Jeff Masarjian	65 Main St Watertown, MA 02472	617-926-0006

Appendix B. List of Important Insects and Diseases

Insects

Latin Name	**Common Name (English)**	**Russian**
Ocneria(Lymantria) dispar	Gypsy Moth	Shelkopryad neparnyy
Malacosoma neustria	Lacky Moth	Kokonopryad kol'chatyy
Euproctis chrysorrhoea	Browntail Moth	Ziatoguska
Evetria buoliana	European Pine Shoot Moth	Pobegov'yuny
Tomicus blastophagus (piniperda)	Common Pine Shoot Beetle	Luboyed bol'shoy sosnovyy prodol'nokhodnyy
Erannis defoliaria	Mottled Umber Moth	Pyadenitsa obdiraioplodovaya
Tortrix viridana	Oak Leaf Roller Moth (Green Oak Tortrix)	Listovertka dubovaya zelyonaya
Aporia crataegi	Blackveined White	Boyaryshnitsa
Melasoma populi	Poplar Leaf Beetle	
Curculio glandium	Weevil	Dolgonosik zheludyovyy
Tomicus minor	Lesser Pine Shoot Beetle	Luboyed malyy sosnovyy
Anthaxia caucasica	Flatheaded Borer	
Carpocapsa (Cydia) pomonella	Codling Moth	Plodozhorka yablonnaya
Aphis pomi	Apple Aphid	Tlya yablonnaya
Eriosoma lanigerum	Wooly Apple Aphid	Tlya krovyanaya yablonnaya
Aspidiotus (Quadaspidiotus) perniciosus	San Jose Scale	Shchitovka kaliforniyskaya

Diseases

Latin Name	**Common Name (English)**	**Russian**
Microsphera alphitoides	Oak Mildew	
Fusarium		
Coleosporium		
Melampsora pinitorgua		
Melamposoraceae (Vredinales)		

Appendix C. Information About the Most Important Pests and Historical Control Approaches

Insects

1) *Ocneria (Lymantria) dispar* --- Gypsy Moth --- Shelkopryad neparnyy
   a. **Location:** Although historically this insect is found throughout Armenia, it is currently found primarily in the central region in the Anaran Forest Enterprise.
   b. **Primary Host:** *Quercus* --- Oak species
   c. **Alternate Hosts:** Fruit trees such as apple and pear
   d. **Damage:** Larvae consume entire leaves except for central vein. Defoliation of the entire crown begins in early spring with the greatest damage occurring in May and June. Feeding is done by all larval stages, the most damage being done by the 4^{th} through the 6^{th} instars and often results in reduced growth and aesthetic value. The most important effect is the environmental degradation caused by tree mortality. This includes erosion, changes in water cycles, and loss of wildlife habitat. Following 3 or more years of defoliation, tree mortality occurs. A drought will accelerate this outcome.
   e. **Predisposition Factors:** Dry sites, open crowns. A drought occurred in 2000 predisposing the oak forests through much of Armenia to attack by defoliating insects.
   f. **Historic Economic Loss:** This insect was introduced to Armenia in the 1930's with the development of agriculture, possibly on infested fruit tree stock. Since the female is known to fly, it is thought that this is the Asian variety. There is no information on economic losses due to gypsy moth in Armenia.
      When damage is noted by the Forest Guards, the information is reported as loss of hectares to Hyantar where a request for control measures is made annually. There are no entomology or pathology specialists in the Forest Enterprises. An estimate of 10% accuracy is thought to prevail in the identification of insects and diseases.
   g. **Historic Control Measures Used:** Bt (*Bacillus thuringiensis*) has been used in the past, commercial formulations from Russia have been Lepidocide® and Bitoxibacilline (BTB-202), from the U.S.A. a commercial formulation of Dipel (Bt kurstaki) has been tried but access to this formulation is difficult. The Biological Technology Institute of Armenia (Agriculture and Plant Protection Center, Anichka Hovsepyan as the contact) has begun to prepare Bt formulations specific to gypsy moth in Armenia. Chemical pesticides have also been used in the past. German formulations of contact/systemic poisons (acephate, Orthene): Calipso and Confidor in doses of 100-200 ml/ha have been used for defoliators as well as sucking insects. Application is aerially by helicopter, which is owned by the government. In order to determine when control is needed, a

formula based on caterpillar counts is used in conjunction with egg mass surveys in the spring and defoliation estimates in the autumn.

   i. **Efficacy:** The efficacy was thought to be very high on these insects even at low doses, but more precise information is not known.
   ii. **Environmental Impacts:** Very few environmental impacts are known to be related to the use of Bt against gypsy moth except the impact on other lepidoptera in the larval stage at the time of spraying. Low doses of the chemical pesticides were used to protect the environment. Soil contamination is a great concern in Armenia and observations of soil fertility and the activity of mico-organisms are made in relation to the use of Bt and other formulations.

h. **Other Known Control Options:**
   i. **Reasons for Non-use:**

i. **Other Control Options Being Studied:** Growth regulators such as Dimilin (diflubenzeron) are being studied by the Biological Technology Institute of Armenia on 3-5 ha plots. These formulations are Match and Injegar and are being formulated to be specific to gypsy moth.

2) *Malacosoma neustria* --- Lacky Moth --- kokonopryad kol'chatyy

a. **Location:** Same as Gypsy Moth
b. **Primary Host:** Same as Gypsy Moth
c. **Alternate Hosts:** Same as Gypsy Moth
d. **Damage:** Same as Gypsy Moth and when occurring together the effects are additive.
e. **Predisposition Factors:** Same as Gypsy Moth
f. **Historic Economic Loss:** Same as Gypsy Moth
g. **Historic Control Measures Used:** Same as Gypsy Moth
   i. **Efficacy:**
   ii. **Environmental Impacts:** Same as Gypsy Moth.
h. **Other Known Control Options:**
   i. **Reasons for Non-use:**
i. **Other Control Options Being Studied:**

3) *Euproctis chrysorrhoea* --- Browntail Moth --- Ziatoguska

a. **Location:** This insect is currently active throughout Armenia wherever oak is growing.
b. **Primary Host:** Oak
c. **Alternate Hosts:** Wild apple and fruit orchards
d. **Damage:** Same as Gypsy Moth and when occurring together the effects are additive.
e. **Predisposition Factors:** Same as Gypsy Moth
f. **Historic Economic Loss:** Same as Gypsy Moth

g. **Historic Control Measures Used:** Same as Gypsy Moth
    i. **Efficacy:**
    ii. **Environmental Impacts:** Same as Gypsy Moth.
h. **Other Known Control Options:**
    i. **Reasons for Non-use:**
i. **Other Control Options Being Studied:** There are currently studies regarding the relationship of temperature and insect survival and development.

4) *Evetria buoliana* --- European Pine Shoot Moth --- Pobegov'yuny
a. **Primary Host:** Pine plantations 3-4 meters in height
b. **Alternate Hosts:** None
c. **Damage:** Malformations and death of the branches and terminal buds, which reduces growth and quality of wood products.
d. **Predisposition Factors:**
e. **Historic Economic Loss:** None known
f. **Historic Control Measures Used:**
    i. **Efficacy:**
    ii. **Environmental Impacts:**
g. **Other Known Control Options:**
    i. **Reasons for Non-use:**
h. **Other Control Options Being Studied:** Two systemic poisons are currently being studied for use to control this insect as well as *Blastophagus minor* and *B. piniperda*. These chemicals are the Russian formulation known as B-58 (dimethoate) and the Japanese formulation known as Omite (propargite). These are only used as experimental treatments over small areas using an ME-8 helicopter carrying 2 tons of the formulation and able to cover 40-50 ha per flight.

Diseases

1) *Microsphera alphitoides* --- Oak Mildew ---
a. Location: Throughout Armenia but currently heaviest in the southern region
b. Primary Host: Oak
c. Alternate Hosts: Beech
d. Damage: Disruption of photosynthesis weakens the tree predisposing it to insect attack such as secondary bark beetles and wood borers.
e. Predisposition Factors:
f. Historic Economic Loss: No information available
g. Historic Control Measures Used: The fungicide Bayleton (triadmefon) from Germany has been aerially applied. Sanitation removals of dead trees have been made to protect the forest.
    i. Efficacy:
    ii. Environmental Impacts:

h. **Other Known Control Options:**

   i. **Reasons for Non-use:**

i. **Other Control Options Being Studied:** IPM studies combining fungicides and insecticides are being made to determine proper dosages of each in Armenian forests.

Appendix D. Forest Code summary for Pests and Diseases

The preamble to the Forest Code of Armenia, 1994, "regulates the legal and management relationships in the sphere of forest resources utilization, is called upon for scientifically based forest protection, regeneration and utilization in relation with its ecological, social and economical significance". The 21 chapters each deal with a variety of forest issues including illegal cutting, forest fires, and **insect and disease control**.

Chapter 1 Article 1 provides the general provisions of the Forest Code including the objectives of the forest legislation including the protection of rights of organizations, agencies, enterprises and citizens in the sphere of forest utilization, regeneration, protection and **pest and disease control**.

Article 6 provides the ability of the state government to organize forest inventory and monitoring. This type of monitoring could include information on **insect and disease** data. The article also authorizes the government to implement international cooperative programs, which could also include **insect and disease control** programs.

Chapter 2 Article 9 provides authorization of the government to control how the established regulations on forest protection and **pest and disease control** are kept.

Article 10 describes the objectives of the owners of the forest estates including to provide fire prevention measures and **pest and disease control**.

Chapter 3 Article 11 provides for the classification of the forests of the Republic of Armenia in accordance with their location and functional uses. The three classifications are protected forests, social forests and forests of special significance [use for priority setting in control activities].

Chapter 12 Article 37 describes the use of the forests for research, providing plots to scientific organizations to carry out this research.

Chapter 14 Article 42 is aimed at increasing the productivity of forest stands through thinning, sanitation cutting, restructuring low quality stands, reforestation, aforestation, and seed orchard improvement.

Chapter 15 Article 46 deals principally with the protection of forests through **insect and disease control** considering the location of the forests and their biological peculiarities.

Article 47 provides the authorization of local Forest Enterprises to carry out **insect and disease control** measures

Article 48 describes the rights and responsibilities of the government and local Forest Enterprises in regard to fire as well as **insect and disease control**:

- ·before the most dangerous time for forest fires approve the action plan against forest fires;
- ·define the order of the involvement of population, organizations, transport and technique for the forest fires' suppression;
- ·provide the fire brigades with transport, food and medical support(first aid);
- ·provide the training of the fire brigades;
- ·encourage the construction of fire control forest roads;
- ·organize the training of the population on forest fires prevention and suppression through mass media;
- ·form special commissions on fire prevention;
- ·ensure the implementation of **pest and disease control**

Article 49 discusses the obligations of the Forest Enterprises in regard to the regeneration of the forests.

Chapter 16 Article 50 describes the rights of the forest protection staff working for the government including uniform allowance, construction materials and fuel wood.

Chapter 17 Article 54 determines payment for **insect and disease control** measures.

Chapter 18 Article 55 describes the data to be collected in the forest inventories. The forest inventory is to contain materials about forest effective use, their production, regeneration, data on forest protection, **pest and disease control** and other data concerning forest management practices.

The Forest Inventory includes:

- ·the borders definition of the forest enterprises and inside organizations;
- ·maps of forest and its location, distribution;
- ·the register of the forest estate, wood species and age classes, the quantitative and qualitative features of the forest resources;
- ·the definition and location of the cutting areas, for main use and for thinnings and sanitation cuttings, as well as the order of their implementation, the kinds of cuttings;
- ·the classification of forests upon their significance;
- ·the accountable cut for all kinds of cuttings;
- ·the definition of the volumes of regeneration, forest protection, utilization and **pest and disease control**;
- ·the definition of the volume of forest by-use and secondary use.
- The forest inventories are to be undertaken by the local Forest Enterprises.

Appendix E: Examples of Forest Pest Alerts:

Example 1 – Common Pine Shoot Beetle

Pest Alert

United States Department of Agriculture

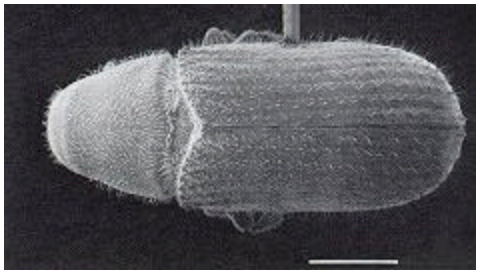
Forest Service

NA-TP-05-93

Common Pine Shoot Beetle, *Tomicus piniperda* (L.)

The common (or larger) pine shoot beetle, *Tomicus* (=*Blastophagus*) *piniperda* (L.), was discovered in Armenia in 19 . Adults of the common pine shoot beetle are cylindrical and range from 3 to 5 mm in length (about the size of a match head). Their head and thorax are shiny black while the wing covers are reddish-brown to black. Eggs are 1 mm long, oval, smooth, and shiny white. Larvae are legless, slightly curved, have a white body and brown head, and can reach 1/4 inch (5 mm) in length when fully grown.

Figure 1.Adult Beetle (Scale line=1mm)



Life History

Figure 2. Mined shoots os Scotch Pine. (Arrow indicates entrance gallery)

Tomicus piniperda completes one generation per year throughout its native range of Europe and Asia. Overwintering adults initiate flight on the first warm (50-54° F) days of spring which probably occurs in February or March in the Armenia Adults quickly colonize either recently cut pine stumps, logs, or, at times, infest the trunks of severely weakened trees. If necessary, adults can fly ½ mile (1 km) or more in search of host material. Pine is the principal host tree. When populations are high, adults may breed in spruce, fir, and larch logs that occur in stands mixed with pine. Various species of blue stain fungi are associated with this bark beetle.

Adults use host volatiles such as alpha-pinene to locate suitable host material for breeding. *T. piniperda* does not appear to produce an aggregation pheromone (sex attractant). Females initiate gallery systems and soon one male joins each female. After mating, females construct individual vertical egg galleries within the inner bark and outer sapwood. Egg galleries extend 4 to 10 inches (10 - 25 cm) in length. Females lay eggs singly in niches that are cut into both sides of the egg gallery. After hatching, larvae construct horizontal feeding galleries that are 1.5 to 3.5 inches (4 - 9 cm) long. Most larvae complete development, pupate, and transform to adults in May and June.

The newly formed adults tunnel through the outer bark, creating circular exit holes about 2mm in diameter. They then fly to the crowns of living, healthy pine trees of all ages, but prefer the taller trees in any particular area. Adults feed primarily inside lateral shoots, mostly in the upper half of the crown from May through October. During this period of maturation-feeding, each adult may destroy 1 to 6 shoots. Scotch pine is preferred, but other pine species have been infested.

Figure 3. Damaged shoots on Scotch Pine.

Adults usually enter shoots in the one-year old or current year's growth. Normally, one beetle infests each shoot. They tunnel into the center and bore outwards, hollowing out 1 to 4 inches of the shoot. After several weeks, adults often emerge and enter other shoots. Infested shoots generally bend near the point where the beetles entered, turn yellow to red, eventually break off, and fall to the ground.

In Armenia, adults exit twigs soon after the first frosts in October and November and enter the thick bark at the base of pine trees to spend the winter. Adults typically overwinter at the base of the same pine tree that supported their maturation feeding. A few beetles may pass the winter inside twigs in the crown.

Damage

The most severe damage caused by *T. piniperda* is the destruction of shoots during maturation feeding. When shoot feeding is severe, tree height and diameter growth are reduced.

Generally, the reproduction phase of this beetle in pine stumps and slash causes little economic damage. However, in China and Poland, *T. piniperda* has attacked and killed apparently healthy pine trees.

For more information contact:

Example 2 - Lackey Moth

Pest Alert

United States
Department of
Agriculture

Forest Service

NA-PR-02-96

Lackey Moth

The Lackey Moth, *Malacosoma neustria*, is an important defoliator of Armenian hardwoods including maple and oak. The Lacky Moth does not build tents but spins silken mats on tree trunks and large branches.

New caterpillars (larvae) hatch in the early spring when leaves begin to grow. The caterpillars eat foliage, and when they are numerous, tree crowns may appear thinner or in the worst situations, they may eat all the leaves on a tree.

1. Oak leaf fed on by caterpillars.

Fully grown caterpillars are about two inches long and have a row of 10-12 footprint-shaped markings down the middle of their backs. After feeding on foliage for several weeks, the caterpillar spins a cocoon on leaves or bark. Light brown moths emerge from the cocoon and mate. Females lay up to 200 eggs in "egg bands" that encircle small twigs. The insect overwinters in the egg stage.

When enormous numbers of caterpillars are present, the situation is referred to as an outbreak. These outbreaks typically occur every 6-16 years. An outbreak may last up to 6 years depending on weather conditions, food (leaves) supply, and natural enemies such as parasites, predators, and diseases. The effect of forest tent caterpillar feeding on trees is usually some dead branches and growth loss. However, when feeding is combined with other factors like drought or disease, a tree may die.

2. The forest tent caterpillar larvae.

3. Heavy defoliation by caterpillars.

4. Egg band on twig.

5. Cocoon on leaf.

Photo Credits: Photo 4: Doug Allen, State University of New York, Photos 1-3 and 5: USDA Forest Service.

For additional information contact:

USDA Forest Service
Forest Health Protection
P.O. Box 640
Durharn, NH 03824
(603) 868-7709

Example 3 – Browntail Moth

BROWNTAIL MOTH
***Euproctis chrysorrhoea* (L.)**

History

The browntail moth was accidentally introduced into Armenia in the 1930's.

Damage

The larval stage (caterpillar) of this insect feeds on the foliage of hardwood trees and shrubs including: oak, , apple, cherry, , and rose. Larval feeding causes reduction of growth and occasional mortality of valued trees and shrubs. While feeding damage may cause some concern, the primary human impact from the browntail moth is the result of contact with poisonous hairs found on the caterpillars. Contact of these hairs with human skin causes a rash which can be severe on some individuals.

Description and Life History

The browntail moth produces one generation a year. It has four life stages; egg, larval, pupal, and adult. The larval or caterpillar stage lasts for 9 months of the year from August through June.

In the fall, colonies of larvae build nests in trees constructed from a single leaf wrapped tightly with large amounts of white silk. A colony consists of 25 to 400 or more larvae. The larvae overwinter within the web nests which are two to four inches long and are situated on branch tips. Eastern tent caterpillar tents which are often confused with these winter nests are found in crotches and forks of apple and cherry tree branches during the spring.

In the spring, as soon as the earliest leaf buds open, the larvae become active and crawl out of their nests to feed on the tender foliage. They may devour the foliage as fast as it develops. For a time the larvae crawl back into the web at night, but as they become larger they remain on the leaves. By late June, larvae are full grown. Large larvae, about 1 1/2 inches long, are dark brown and have a broken white stripe on each side of the body and conspicuous, unpaired, reddish spots on the posterior end of the back. These should not be confused with larvae of the eastern tent caterpillar which has a single, solid, white stripe down its back or the gypsy moth which has paired blue and red spots on its back.

In late June, the larvae spin rough cocoons in which to pupate. The pupae develop into moths which emerge from the cocoons in July. The moths have a wingspread of about 1 1/2 inches. Wings and midsection are pure white. The abdomen (rear part of the body) is brown with a conspicuous tuft of brown hairs at the tip.

After emerging, the females lay eggs in masses on the underside of leaves and cover the eggs with brown hairs from their bodies. Each female lays 200 to 400 eggs. The eggs hatch during August or early in September and the young larvae feed for a short time on the leaves before building their winter webs. This fall feeding does little damage to the trees.

Control

Non-chemical: Control of browntail moth populations in isolated instances may be obtained by clipping the overwintering webs and destroying these webs by either soaking in water and detergent or burning them. This control should be undertaken in the fall and winter, from September to late March.

Chemical*: Should populations increase to such proportions as to make hand clipping impractical, pesticide application may be necessary. The pesticides should be applied as directed, when caterpillars are present and feeding, from early May through the end of June. Products containing carbaryl, methoxychlor, acephate or other insecticide registered to control pests on shade trees, shrubs, and ornamentals around the home should provide acceptable control results. Only registered fruit tree formulations should be used on apple and other fruit trees. Any pesticide used should be applied according to directions on the label and all precautions should be followed.

***NOTE**: These recommendations are not a substitute for pesticide labeling. Read the label before applying any pesticide.

Caution: For your own protection and that of the environment, apply the pesticide only in strict accordance with label directions and precautions.

Forecast

At this time it is not possible to accurately predict the future populations of this pest in Armenia